

EL MUSEO EN LA ARQUITECTURA DOCENTE DE MIES VAN DER ROHE: LA FIESTA DEL ARTE

THE MUSEUM IN THE EDUCATIONAL ARCHITECTURE OF MIES VAN DER ROHE: THE FESTIVAL OF ART

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Resumen

Mies van der Rohe exploró el proyecto de museo como arquitecto y como docente, y confirió un nuevo entendimiento acerca del significado del mismo: un espacio destinado al *disfrute del arte*. Si bien los museos que Mies realizó en su estudio han sido publicados y analizados por la crítica, se desconoce la investigación académica que desarrolló en torno a esta tipología. Por ello, el presente artículo tiene por objeto: dar a conocer los proyectos-museo que Mies supervisó en el programa de postgrado del IIT -en concreto las tesis fin de máster de Daniel Brenner, Jean Lippert y Peter Carter; realizar un estudio comparativo de dichas tesis, tomando como base los conceptos que el propio Mies manifestó en el texto del Museo para una Pequeña Ciudad; y exponer las invariantes que se mantienen en estos espacios destinados a la *fiesta del arte*, estableciendo conexiones entre la arquitectura del maestro y la de sus alumnos.

Abstract

Mies van der Rohe explored the museum project both as an architect and as a teacher, and contributed towards a new way of understanding its meaning: a space for the *enjoyment of art*. Although critics have already published articles about the museums that Mies created in his office, and analysed them in detail, nothing is known about the academic research he carried out on this type of building. For this reason, the purpose of this article is: to present the museum-projects that Mies supervised on the graduate programme at the IIT -specifically the final master's theses of Daniel Brenner, Jean Lippert and Peter Carter; to carry out a comparative study of these theses, based on the concepts that Mies himself expressed in the text of the Museum for a Small City; and to explore the constant aspects that are maintained in these spaces destined for the *festival of art*, establishing connections between the architecture of the Mies, and that of his students.

Palabras clave

Mies van der Rohe, museo, disfrute, fiesta del arte, docencia de postgrado IIT

Keywords

Mies van der Rohe, museum, Enjoyment, Festival of Art, graduate teaching at the IIT

“El valor de (un) museo se basa en la calidad de sus obras de arte y en la manera cómo están expuestas. El primer problema consiste en concebir el museo como un centro para disfrutar el arte, no para conservarlo”¹. Con estas palabras Mies van der Rohe comienza el texto que acompaña el proyecto del Museo para una Pequeña Ciudad, iniciado en 1941 y publicado en *Architectural Forum* en 1943. Es en este momento, años después de emigrar a Chicago y ejerciendo como director del Departamento de Arquitectura del Armour Institute of Technology, cuando Mies se plantea por primera vez ¿qué es? y ¿qué no es? un museo. La respuesta es clara: *es un espacio para la fiesta del arte*. Así pues, los primeros trabajos que desarrolla en suelo americano, la Casa Resor, el Concert Hall y el Museo para una Pequeña Ciudad marcan un punto de inflexión en su pensamiento y en su obra. A partir de entonces, su arquitectura comienza un proceso de revisión y superación de los planteamientos europeos y la correspondiente puesta en valor de lo que considera sustancial en su arquitectura.

Este artículo, respondiendo a la temática ¡Toca fiesta! / Let's party!, tiene por objeto profundizar en el concepto de museo visto desde la óptica de Mies van der Rohe: el museo como espacio vinculado al *disfrute del arte*. No obstante, lo hace desde un enfoque nuevo y complementario, razón por la cual esta investigación deja al margen los museos que Mies desarrolló en su estudio, y que han sido profusamente publicados y comentados², y da a conocer los proyectos académicos de espacio-museo que dirigió en el programa de postgrado del Illinois Institute of Technology. Para ello, en primer lugar, se analiza el primer escrito de Mies referido a un proyecto de museo -la memoria del Museo para una Pequeña Ciudad; a continuación, se hace un estudio comparativo de las tesis supervisadas por Mies y que abordaron esta temática -los trabajos realizados por Daniel Brenner, Jean Lappert y Peter Carter; y finalmente se exponen las invariantes que se mantienen en estos proyectos, estableciendo algunas conexiones con la arquitectura, construida o no, de Mies. Evidentemente, la extensión de estas

“The value of such a museum depends upon the quality of its works of art and the manner in which they are exhibited. The first problem is to establish the museum as a centre for the enjoyment, not the interment of art”¹. With these words Mies van der Rohe starts the text that accompanies the project of the Museum for a Small City, begun in 1941 and published in *Architectural Forum* in 1943. It is at this moment, years after migrating to Chicago and working as Director of Architecture at Armour Institute of Technology, that Mies first asks what a museum is, and what a museum is not. The answer is clear: *it is a space for the festival of art*. Thus, his first works on American soil, the Resor House, the Concert Hall and the Museum for a Small City, mark a turning point in his thought and work. From then on, his architecture begins a process of revision and overcoming European approaches and the corresponding enhancement of what he considers substantial in his architecture.

This article, responding to the theme ¡Toca fiesta! / Let's party! aims to explore the concept of the museum seen from the perspective of Mies van der Rohe; the museum as a space associated with the *enjoyment of art*. However, it does so from a new and complementary approach, which is why this research leaves aside the museums that Mies designed in his studio, which have been profusely published and commented on², and instead examines the academic projects for museum spaces that he supervised in the graduate programme of the Illinois Institute of Technology. In order to do so, we begin by analysing Mies' first paper referring to a museum project -the study for the Museum for a Small City; then, a comparative study is made of the theses supervised by Mies and which dealt with this subject matter -the projects carried out by Daniel Brenner, Jean Lappert and Peter Carter; and finally, the constant elements that are maintained in these projects are discussed, establishing a series of connections with Mies' architecture, whether it was built or not. Obviously, the length of this



líneas no nos permite más que insinuar líneas de investigación y abrir nuevas perspectivas para el debate científico.

El concepto de museo de Mies van der Rohe: Museo para una Pequeña Ciudad.

El cambio en el pensamiento miesiano, comienza a manifestarse en su discurso de ingreso como director del Departamento de Arquitectura del AIT, momento en que expresa la relación indisoluble entre estructura y espacio (Fig. 01)³. No obstante, es poco después, en la memoria del Museo para una Pequeña Ciudad, cuando Mies muestra un cambio sustancial en su modo de concebir la arquitectura. El proyecto parte de un encargo nada convencional que responde a un número especial de la revista *Architectural Forum* titulado “New Buildings for 194X” en el cual una selección de arquitectos diseña edificios concretos para la reconstrucción de vacíos urbanos en ciudades de postguerra. Tal y como muestra la investigación llevada a cabo por Cammie MacAttee, y de acuerdo con la correspondencia entre Mies y Howard Myers, editor de la revista, aunque el encargo solicita el diseño de una iglesia, Mies responde ofreciéndose a proyectar un museo de arte moderno⁴. ¿Por qué

article only allows us to insinuate lines of research and to open up new perspectives for scientific debate.

The museum concept of Mies van der Rohe: Museum for a Small City.

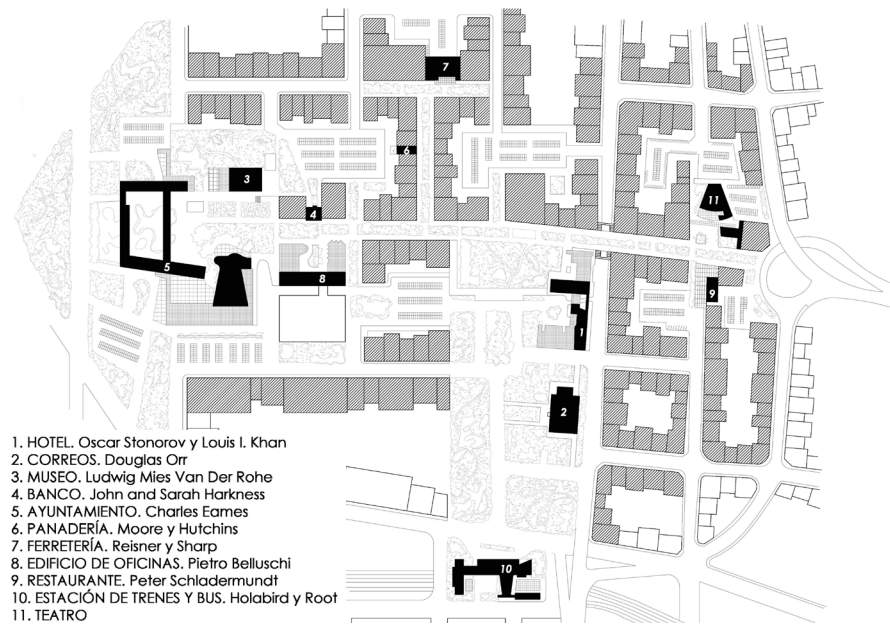
The change in Mies’ way of thinking begins to manifest itself in his inaugural address as Director of Architecture at AIT, a moment in which he expresses the indissoluble relationship between structure and space (Fig. 01)³. However, it is not long after, in the study of the Museum for a Small City, that Mies reveals a substantial change in his way of conceiving architecture. The project is based on an unconventional commission that responds to a special issue of the *Architectural Forum* magazine entitled “New Buildings for 194X” in which a selected group of architects design specific buildings for the reconstruction of urban spaces in post-war cities. As Cammie MacAttee’s research shows, and according to the correspondence between Mies and Howard Myers, the editor of the magazine, although the commission called for the design of a church, Mies responded by offering to design a museum of modern art⁴. Why design a

Fig. 01. Discurso de ingreso como director del Departamento de Arquitectura del Armour Institute of Technology, (Chicago), 1938.

Fig. 01. Inaugural Address as Director of Architecture at AIT, (Chicago), 1938.

Fig. 02. Architectural Forum 78, 1943, *Museum for a Small City*; plano de emplazamiento.

Fig. 02. Architectural Forum 78, 1943, *Museum for a Small City*; site plan.






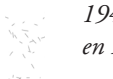


proyectar un museo en lugar de una iglesia? Porque para Mies el museo era la tipología más representativa de la nueva época y donde mejor podría plasmar su filosofía arquitectónica⁵ (Figs. 02, 03, 04 y 05).

Del análisis del Museo para una Pequeña Ciudad se destacan tres aspectos fundamentales. En primer lugar, el modo en que Mies empieza a esencializar los conceptos. Mies ya no se conforma con un programa funcional, sino que va hacia el núcleo del ser y se pregunta por lo importante: ¿qué es un museo? Sólo dando respuesta a la cuestión del ser de las cosas, de las necesidades de la época, se conseguirá una arquitectura que satisfaga, desde su inicio a la sociedad de la época; sólo así, superando la respuesta funcional tradicional, se alcanza el reino de lo auténtico, su razón de ser. ¿Filosofía o Arquitectura? ¿Qué más da! Ambas se identifican. Para Mies la arquitectura, al igual que la filosofía, busca la verdad. Por ello, cuando plantea el Museo para una Pequeña Ciudad y se cuestiona ¿qué es? su respuesta no puede ser más ilustrativa: “un museo es un espacio para disfrutar del arte”⁶. Pero este cambio no se puede encasillar en una tipología concreta, sino que tiene consecuencias en sus principios arquitectónicos: surge la necesidad de superar la función mediante la arquitectura. Mies busca el concepto abstracto del *espacio universal*: la evidencia de la razón y del espíritu,

museum instead of a church? Because for Mies, the museum was the most representative typology of the new era, and where he could best reflect his architectural philosophy⁵ (Figs. 02, 03, 04 and 05).

The analysis of the Museum for a Small City highlights three fundamental aspects. First of all, the way Mies starts to essentialise the concepts. Mies is no longer satisfied with a functional programme, but instead turns towards the core of being and asks himself what is important: what is a museum? Only by answering the question of the being of things, of the needs of the time, will we achieve an architecture that satisfies the society of the time from the outset; only in this way, surpassing the traditional functional response, will we reach the realm of the authentic, its *raison d'être*. Philosophy or Architecture? What difference does it make! Both are identified. For Mies, architecture, like philosophy, seeks truth. Therefore, when he proposes the Museum for a Small City and asks himself what it is, his answer could not be more illustrative: “a museum is a center for the enjoyment of art”⁶. Nevertheless, this change cannot be pigeonholed in a specific typology, but has consequences for his architectural principles: the need arises to overcome function through architecture. Mies

HOTEL	page 74		OSCAR STONOROV AND LOUIS I. KAHN have been working together, in association with George Howe of Philadelphia, since 1940. Stonorov was educated at Florence and Zurich, and immigrated to the U. S. in 1929. Kahn got his degree in architecture from the U. of Penn. in 1934. Both have worked extensively in private and public housing.	HARDWARE STORE	page 106		ZEDD S. REISHER AND J. STANLEY SHARP are graduates of the Universities of Illinois and New York, respectively. Reisher won the Plym Fellowship (1938), spent 2 years in France and Scandinavia, is now with Harrison, Foxbourn & Abramowitz. Sharp worked for Edward D. Stone for 3 years, and has spent the last two on defense projects.
POST OFFICE	page 80		DOUGLAS ORR received his architectural education at Yale (B.F.A., M.F.A.) and traveled abroad on the William Wirth Winchester Fellowship. He opened his New Haven, Conn. office in 1919, and has since maintained a general practice. His collaborator, Robert McMillan, is a student at the Yale School of Architecture.	OFFICE BUILDING	page 108		PIETRO BELLUSCHI was born in Ancona, Italy, in 1899, and educated at the University of Rome, later at Cornell. He joined the office of A. E. Doyle in 1925, becoming chief designer after two years. Practicing under his own name, Mr. Belluschi has designed many buildings in the Pacific Northwest, is President of the Oregon Chapter, A.I.A.
CHURCH	page 82		LORIMER RICH is a graduate of Syracuse University who received his early training in the offices of McKim, Mead & White and Charles A. Platt. He has practiced independently in New York since 1929, specializing in public and semipublic buildings such as post offices, court houses, etc. Now engaged in hospital work and city planning.	MOVING PICTURE THEATER	page 113		CARL KOCH AND JOHN JOHANSEN were graduated from the Harvard Graduate School of Design in 1937 and 1941. Koch held the Bacon Traveling Fellowship, 1938-39, had his own practice from 1939 to 1942, and is now Senior Research Technician with the NHA. Johansen has worked on housing and postwar planning, is also with the NHA.
MUSEUM	page 84		LUDWIG MIES VAN DER ROHE , one of the world-famous founders of modern architecture and foremost exponent of the "open" plan, is the son of an Aix-la-Chapelle stone mason, never received formal technical training. Now professor of architecture at the Armour Institute of Technology, Chicago, he first began to practice in Berlin in 1911.	RESTAURANT	page 116		PETER SCHLADERMUNTZ was born in Bronxville, N. Y., in 1907. He was graduated from the Yale School of Architecture in 1929, worked with Raymond Hood and Henry Dreyfus. His independent work has been primarily for Chase Brass & Copper Co., Adolph Zukor and General Cable Corp. Since 1938 he has been with Norman Bol Goddard as lead designer.
BANK	page 86		JOHN C. HARKNESS AND SARAH HARKNESS are recent graduates of the Harvard Graduate School of Design and Cambridge School of Architecture, respectively. John Harkness won the Second A.I.A. Medal in 1941, and together with his wife Sarah, the Boston Society of Architects Prize in 1940. Both are now working in New York offices.	MOTOR CAMP	page 120		ERNEST PAYER was born in Vienna in 1904, studied sociology, economics, international law, and, later, architecture with Josef Hoffmann. After coming to the U. S. in 1936 he studied at the Harvard Graduate School of Design for two years. He has done cabinet work, worked in a lumber camp and saw mill, and designed a number of excellent houses.
CITY HALL	page 88		CHARLES EAMES was born in St. Louis, Mo. in 1907 and studied architecture there at Washington University. He has worked for Eliel and Eero Saarinen, taught design at Cranbrook Academy of Art. With Eero Saarinen, he won a first prize in the Organic Design Competition of the Museum of Modern Art. Now doing experimental work for the Government.	AIRPORT	page 123		ANTONIN RAYMOND was born in Prague in 1889, where he received his degree as Architect-Engineer. In 1916 he joined Frank Lloyd Wright, with whom he went to Japan four years later. He practiced there until 1928, when he returned to the U. S. to design private residences, housing developments and numerous large projects for the War Dept.
HIGH SCHOOL	page 91		PERKINS, WHEELER AND WILL of Chicago are perhaps best known for their collaboration with the Saarinen on the Crow Island School. Lawrence Perkins and Philip Will, Jr., were roommates at Cornell, graduating in 1929 and 1932. E. Todd Wheeler is now doing postwar planning for the state of Illinois, has left the firm for the duration, is not pictured here.	RAILROAD-BUS TERMINAL	page 129		JOHN A. HOLABIRD AND JOHN W. ROOT were graduated together from the Ecole des Beaux Arts in 1913, and joined the firm of Holabird & Roche in 1918. Since that time their office has been one of the most successful in the U. S., designing many large structures, including the Chicago Daily News Building and the new Statler Hotel in Washington.
TRADE SCHOOL	page 95		RALPH WALKER (Voorhes, Walker, Foley & Smith) was graduated from the Mass. Institute of Technology in 1916, traveled abroad on the Roth Traveling Fellowship. Designer of many of the country's big telephone and insurance buildings, he was awarded the gold medal of the Architectural League of New York in 1927, is a Fellow of the A.I.A.	SERVICE STATION	page 132		WILLIAM LESCAZE was born in Geneva in 1896, studied under Karl Moser, and came to the U. S. in 1920. A pioneer of modern architecture in this country, his designs include the Philadelphia Savings Fund Society office building (with George Howe), CBS studios, the Aviation Bldg. and Swiss Pavilions at the N. Y. World's Fair, and the Longfellow Building, Washington.
SUPERMARKET	page 98		J. GORDON CARR studied engineering and architecture at M.I.T., marketing and industrial production at Harvard. After working for Raymond Hood and for Eric Mendelsohn in Berlin, he opened his own office in New York, designed the Aviation Building (with William Lescaze) and the House of Jewels at the New York World's Fair.	HOUSE FACTORY	page 134		CALVER HORNBOSTEL was born on Long Island in 1904. Son of the famous Pittsburgh architect, he studied at the Carnegie Institute of Technology and the Ecole des Beaux Arts. In practice for himself since 1933, he has built a number of houses in France and the U. S., won the Worcester College Art Center competition with Richard M. Bennett in 1938.
SHOPPING CENTER	page 101		GRUENBAUM AND KRUMMECK , of Hollywood, Calif., have designed retail stores in all parts of the U. S., as well as apartment interiors and industrial products. Before their association in 1939, Elsie Krummke worked in the exhibit field (auto shows, Chicago and New York fairs), while Victor Gruenbaum practiced architecture in Vienna.	PARK APARTMENTS	page 138		SERGE CHERMAYEFF practiced architecture in Great Britain, designed the Bechthel Pavilion with Eric Mendelsohn. In the U. S. since 1940, he is now professor of architecture at Brooklyn College. Collaborator Abel Sorensen worked in Denmark, France and the U. S. for 4 years. Peter Blach was with Chermayeff in London, has worked here since 1940.
BAKERY & CANDY STORE	page 104		MOORE AND HUTCHINS won first prize in a national competition for Goucher College, Baltimore, Md., and have designed numerous commercial and residential buildings in the New York area. John C. B. Moore studied at Harvard and the Ecole des Beaux Arts (1927), Robert S. Hutchins at the U. of Penn. Both got their early training with Delano & Aldrich.	HOSPITAL	page 146		HUDSON STUBBINS, JR. was born in Birmingham, Ala., in 1912 and studied architecture at Georgia Tech. (B.S., 1933) and Harvard (M.A., 1935). He was third prize in the Smithsonian Competition (1939), and has designed outstanding war housing projects. Now in private practice and an instructor at the Harvard Graduate School of Design.
				HEALTH FACILITY	page 150		ISADORE ROSENFELD AND SIMON BREINES collaborated on this project after working together on a postwar hospital for the City of New York. Rosenfield is Chief Architect of Hospitals in the N. Y. Dept. of Public Works, Breines a member of the firm of Pomranco & Breines, American architects for a number of the foreign pavilions at the N. Y. World's Fair.

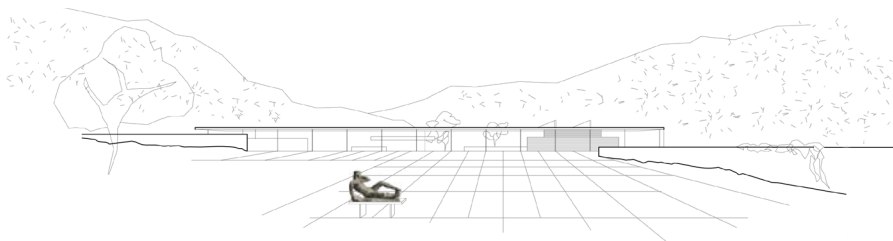
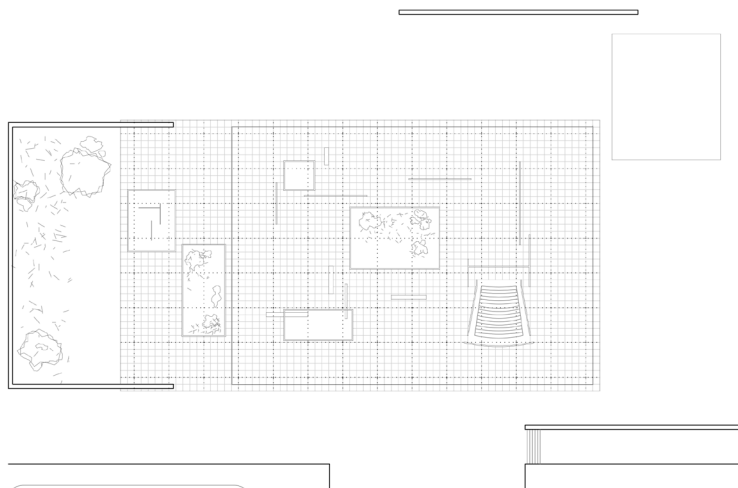


Fig. 03. Architectural Forum 78, 1943; arquitectos que colaboraron en New Building for 194X.

Fig. 04. Architectural Forum 78, 1943, Mies van der Rohe, Museum for a Small City; planta y alzado

Fig. 03. Architectural Forum 78, 1943; architects who collaborated on New Building for 194X.

Fig. 04. Architectural Forum 78, 1943, Mies van der Rohe, Museum for a Small City; plan and elevation.



Mies van der Rohe
Project: Museum for a small city. 1942

la simplificación y estandarización de la construcción, la lógica de la estructura. La arquitectura que elimina todo lo que no es esencial y trasciende la función, entendida como compartimentación del espacio. Por contra, su arquitectura americana ofrece un espacio unitario, capaz de absorber distintas funciones la simplificación y estandarización de la construcción, la lógica de la estructura. La arquitectura que elimina todo lo que con flexibilidad y asegurar su perseverancia en el tiempo⁷.

Por otro lado, el espacio-museo reivindica una estructura concebida como parte inherente del espacio arquitectónico; sin ella no se puede construir esta arquitectura. Así, el edificio solamente está compuesto por tres elementos, siendo los tres estructura: “la estructura, que permite construir un espacio de esas características, sólo puede realizarse con acero. De esta manera, el edificio únicamente está formado por tres elementos básicos: una losa en el suelo, pilares y un forjado en la cubierta”⁸.

Además, la voluntad de Mies, tal y como explica Wolf Tessentoff⁹ lleva implícita la descalificación del término tradicional del templo museístico, asimilado como contenedor hermético del arte: “el espacio arquitectónico, así configurado, es una definición volumétrica, más que un confinamiento espacial”¹⁰. El museo debe hacerse para el disfrute del arte, sin barreras, el arte no sólo es veneración. A diferencia del concepto decimonónico de museo, el nuevo espacio cultural debe abrirse, a fin de encontrar contacto directo con el exterior: el arte se convierte en parte integrante de la vida. Los cuadros y las esculturas se utilizan como paredes y pilares que definen el espacio puesto que “para Mies el tema principal no era contener el arte en la arquitectura, sino utilizar el arte para crear arquitectura”¹¹. Por ese motivo, sus collages representan en primer plano los cuadros y casi nada el espacio, nunca sus límites... porque el espacio-museo no es más que el marco donde el hombre disfruta y festeja la cultura del arte. Estos mismos conceptos, y su representación, ya fueron empleados por Mies en la Casa Resor, donde el cuadro sin marco determina

seeks the abstract concept of *universal space*: the evidence of reason and the spirit, the simplification and standardization of construction, the logic of structure. The architecture that eliminates all non-essentials and transcends functional requirements, i.e. spatial compartmentalization, and provides instead a fluid, open-plan space able to cater for different functions and thereby ensure it survives the passage of time⁷.

On the other hand, the museum-space asserts a structure that is conceived as an inherent part of the architectural space; without it, this architecture cannot be built. And so, the building is only composed of three elements, the three structures being: “The structural type permitting this is the steel frame. This construction permits the erection of a building with only three basic elements - a floor slab, columns and a roof plate”⁸.

Moreover, Mies’ objective, as Wolf Tessentoff⁹ explains, implies the disqualification of the traditional term of the museum temple, assimilated as a hermetic container of art: “the architectural space, thus achieved, becomes a defining rather than a confining space”¹⁰. The museum must be made for the enjoyment of art, without barriers: art is not only veneration. Unlike the nineteenth-century concept of the museum, the new cultural space must be opened in order to seek direct contact with the outside world: art becomes an integral part of life. The paintings and sculptures are used as walls and pillars that define the space since “for Mies the main point was not to contain the art with the architecture but to use the art to create architecture”¹¹. For this reason, his collages represent the paintings in the foreground, and hardly any of the space, never its limits... because the museum-space is nothing more than the frame within which people enjoy and celebrate the culture of art. These same concepts, and their representation, had already been used by Mies at the Resor House, where the frameless painting

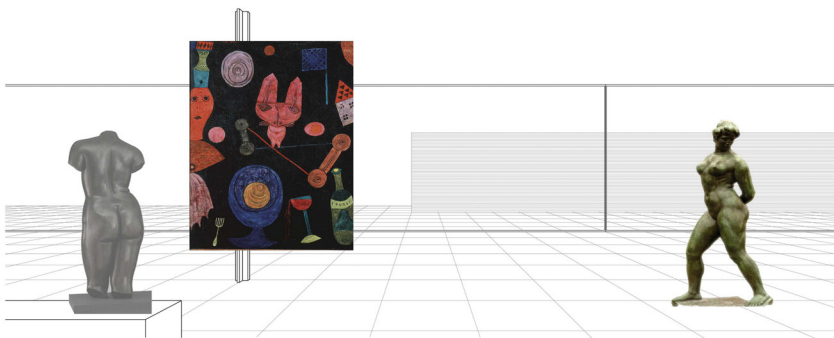
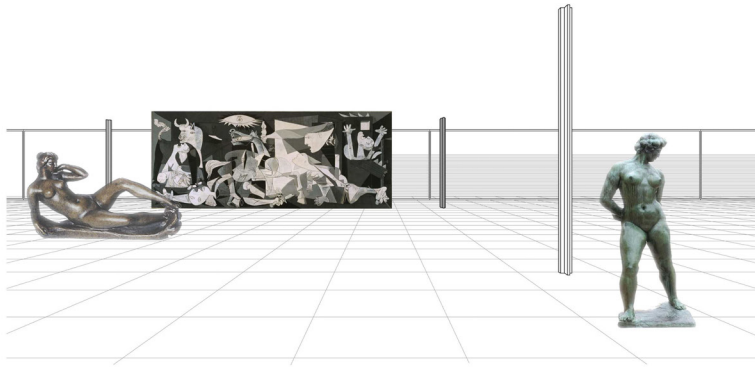


Fig. 05. Architectural Forum 78, 1943, Mies van der Rohe, Museum for a Small City; perspectivas collage.

Fig. 05. Architectural Forum 78, 1943, Mies van der Rohe, Museum for a Small City; collage perspectives.

la organización espacial y protege el exterior, un entorno que aparece bidimensional e inaccesible al espectador: “Todas las vistas a través del vidrio se ven interrumpidas rápidamente por las superficies planas bidimensionales (...) El exterior siempre conserva la lógica del interior (...) El interior simplemente se expande para absorberlo todo”¹².

Y como consecuencia de invertir los papeles en cuanto al ‘significado de arte y arquitectura’, ‘objeto y envolvente espacial’ y ‘cuadro y paisaje’, “la obra de arte pasa a formar parte de la cotidianeidad”¹³, un arte accesible que ahora convierte a toda la sociedad en solemne.

Mies van der Rohe y la investigación del museo a través de la docencia en el IIT.

No se debe asociar el legado de Mies van der Rohe únicamente a su labor como arquitecto, ya que desde que comenzó a ser profesor de la Bauhaus en 1930 hasta que se retiró como docente del IIT en el curso 1958-59, nunca dejó de enseñar arquitectura. Era tal la importancia que concedía a la docencia, que sólo aceptó emigrar a los Estados Unidos cuando sus exalumnos le recomendaron Chicago como lugar ideal para ejercer de arquitecto y profesor. Mies asumió la dirección del Departamento de Arquitectura del AIT implementando un nuevo plan de estudios que, además de una educación de grado, ofrecía un programa de posgrado. Era en ese escenario donde los alumnos desarrollaban un proyecto-tesis dentro de un contexto y unos requerimientos específicos y mediante un sistema estructural acorde con la escala y carácter del edificio. Todo ello posibilitaba que Mies tuviera la oportunidad de estudiar problemas reales en profundidad, dentro de un ambiente distendido, experimental y creativo, tal y como han narrado algunos de sus alumnos (Fig. 06)¹⁴.

Resulta claro que para Mies, la labor docente de la arquitectura estaba íntimamente unida al trabajo profesional de arquitecto: el ejercicio de la profesión conllevaba la necesidad de trasladar la

spatial arrangement and protects the exterior, an environment that appears two-dimensional and inaccessible to the viewer: “All of the views through the glass are quickly terminated by flat two-dimensional surfaces (...) The outside always retains the logic of the inside (...) The interior simply expands to absorb everything”¹².

And as a consequence of reversing the roles in terms of the ‘meaning of art and architecture’, ‘object and spatial envelope’ and ‘painting and landscape’, “the work of art becomes part of everyday life”¹³, an accessible art that now makes all of society solemn.

Mies van der Rohe and museum research through his teaching at the IIT.

Mies van der Rohe’s legacy should not be associated solely with his work as an architect, as from the moment when he became a professor at the Bauhaus in 1930 until he retired as a professor at the IIT in 1958-59, he never stopped teaching architecture. The importance he attached to teaching was such that he only agreed to migrate to the United States when his former students already living there suggested Chicago as the perfect place for an architect and lecturer. Mies took over the Architecture Department at AIT, implementing a new curriculum which, in addition to an undergraduate education, offered a graduate program. It was in this setting that the students developed a thesis project within a context with specific requirements, and by means of a structural system in accordance with the scale and character of the building. All of this allowed Mies to have the opportunity to examine real-life problems in depth, in a relaxed, experimental and creative environment, as some of his students have explained (Fig. 06)¹⁴.

Mies obviously regarded the teaching of architecture as an integral part of an architect’s career: practicing architects needed to share their experience in the classroom, and the classroom was a



Fig. 06. Anuario del IIT, 1941; imagen p. 45.

Fig. 06. Yearbook IIT, 1941; image p. 45.

experiencia a las aulas, y en las aulas se ensayaban nuevos caminos a explorar en la vida profesional¹⁵. En consecuencia, no es casualidad que las casas patio enseñadas por Mies en la Bauhaus coincidieran temporalmente con las casas patio desarrolladas en su estudio o con las viviendas unifamiliares construidas para clientes reales. Tampoco que muchos de los proyectos de sus alumnos de IIT sean de la misma tipología que sus proyectos profesionales. Por ello, para el presente artículo resulta de interés conocer los trabajos de posgrado en donde maestro y alumnos investigaban la génesis de un nuevo concepto de espacio-museo.

Tal y como indica la tabla aportada (Fig. 07), existen tres tesis fin de máster de alumnos de postgrado del IIT que estudian la tipología museística¹⁶. Conviene señalar que estos datos no responden a la totalidad de los proyectos que Mies supervisó, sino a los que durante esta investigación se han localizado en los fondos del Graham Resource Center y en los Archivos del IIT. Por orden cronológico, los proyectos-tesis de espacio museístico son los siguientes: "An Art Museum" desarrollado por Daniel Brenner en 1949¹⁷; "A Museum" de Jan Lippert en 1956¹⁸; y el realizado por Peter Carter en 1958 también titulado "An Art Museum"¹⁹.

laboratory for trying out new methods to be explored in professional¹⁵. architecture. It is no coincidence that Mies' courses at the Bauhaus featured courtyard houses at the same time as courtyard houses were being developed in his studio and detached houses were being built for real-life customers. Nor is it a coincidence that many of the projects by his IIT students involved the same type of constructions as his professional projects. For the purpose of the present article it would, therefore, be useful to know which post-grad projects involved joint research by students and Mies about the creation of a new concept of space-museum.

As indicated in the table provided (Fig. 07), there are three final master's theses by graduate students from the IIT that study museum typology¹⁶. It should be noted that these data do not correspond to all the projects that Mies supervised, but to those that were identified as a part of this research in the collection of the Graham Resource Center and in the IIT Archives. In chronological order, the museum space thesis projects are as follows: "An Art Museum" prepared by Daniel Brenner in 1949¹⁷; "A Museum" by Jan Lippert in 1956¹⁸; and the one by Peter Carter in 1958 also entitled "An Art Museum"¹⁹.

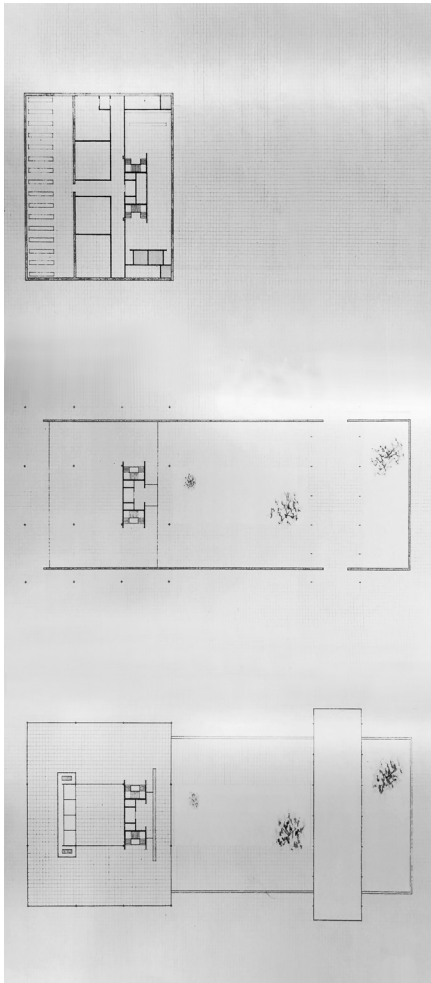
OFICINA / OFFICE	1930-1935 Court Houses	1942 Museum for a Small City	1954 Convention Hall	1962-1968 Neue Nationalgalerie
ESCUELAS / SCHOOLS	Bauhaus Dessau and Berlin 1930-1933	Armour Institute Art Institute, Chicago 1938-1949	Illinois Institute of Technology Alumni Hall, Chicago 1949-1956	Illinois Institute of Technology Crown Hall, Chicago 1956-1958
AULA / CLASSROOM	1930. Court House. E. Ludwig 1930. Court House. H. Dearstyne 1931. L-shaped House. P. Pahl 1931-32. Bachelor's Apartment. H. Neuy 1932. Apartment House. W. J. Hess 1932. Expandable House. H. Hoffman 1932. Summer House. R. Ortner 1933. Single Family House. E. L. Beck 1933. Single Family House. G. Conrad 1933. Three Single Family Houses. E. Hegel 1934-35. Court House. M. van Beuren 1935. Three Court Houses. F. Trudel	1939. Space concept in modern domestic architecture J. Speyer 1941. School of Art & Architecture. C. Worley 1949. An art Museum. D. Brenner 1949. The theatre: historical development and possibilities F. R. Malcomson	1950. A Concert Hall. L. Klarich 1950. The Small Catholic Church. E. Olencki 1951. The Student Union. Y. C. Wong 1951. Student Housing for a University. D. Tamminga 1951. A Protestant Church. F. P. Glastra Van Loon 1951. A Field House. G. R. Summers 1951. The Student Dining Hall. J. Polar 1951. The University Administration Building. W. T. Lo 1951. Replanning a University Campus. J. Ferris 1951. The University Library. R. Durand 1952. A Recreation Social Center. E. N. Zisook 1952. An Industrial Exhibition Hall. J. W. Sugden 1952. An Arts' Club. V. Jansone 1952. A Study of a Union Building. M. Blanckstein 1953. A Synagogue & Community Center. P. J. Hart 1953. Architecture and Design Building. F. P. Seidel 1953. An Arts Center. N. D. Haid 1953. Tall Building: effects of scale. M. Goldsmith 1953. A Suburban Shopping Center. Y. J. Fujikawa 1953. A Public Library. I. I. Coop 1953. A Chapel (non-denominational). I. L. Rocah 1954. Study of Multi-Storied Skeleton Building G. L. Peterhans 1954. A Community Hall for a City of 4000 people H. D. Stubbsjeon 1954. A Convention Hall Y. Miwa, H. Kanazawa & P. C. Chang 1954. A Steel and Glass House. J. Brownson 1955. Interior Studies of a Large Hall A. K. Ramos & J. K. Viks 1956. The suburban office Building. P. R. Campagna 1956. A Museum I Jan Lippert 1956. A non-denominational Church. P. Roesch	1957. An Office Building. G. Rothe 1957. A Public Library. E. B. Hicaro 1958. Housing development with Shopping Center A. Rimavicius 1958. Local Service Airport and Terminal Building R. Kantaputra 1958. A Shopping Center. L. J. Johnson 1958. An Art Museum. P. Carter

Fig. 07. Tabla que lista los trabajos fin de máster supervisados por Mies y los pone en relación con su arquitectura.

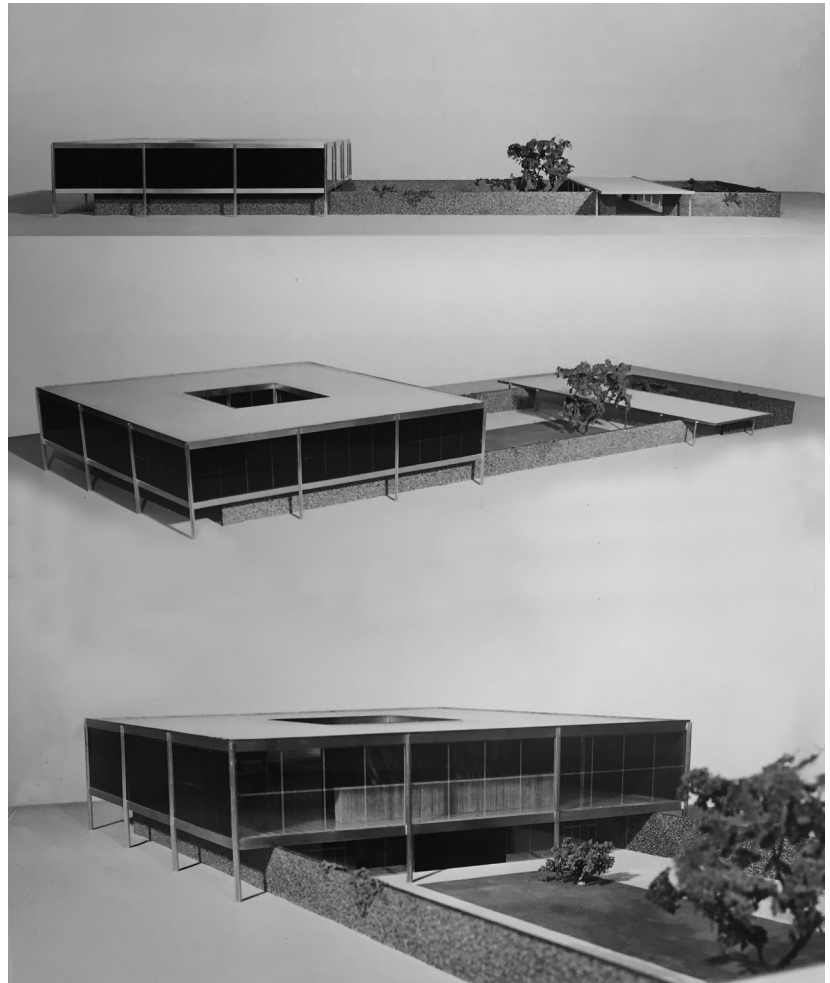
Fig. 07. Table listing the final master's degrees supervised by Mies and relating them to his architecture.

El proyecto de Daniel Brenner para la ciudad de Madison, deja claro en su introducción que está inspirado en el Museo para una Pequeña Ciudad²⁰, y, al igual que ya hiciera Mies, incide en concebir el museo a partir de una estructura conformada por tres elementos básicos, -techo, suelo y columnas,- patios y un espacio flexible²¹. El esquema estructural propuesto presenta una geometría cuadrada de división clásica del cuadrado en 3 x 3 módulos, en donde cada vértice corresponde con un pilar cruciforme, formalizado a partir de la soldadura del equivalente a un perfil europeo IPN y dos medios IPN. El programa funcional ya no se resuelve en una única planta sino en tres niveles diferenciados: la planta baja y la planta primera funcionan como espacios más o menos flexibles, diáfanos, gracias a la disposición de un núcleo de mármol que contiene las instalaciones y circulaciones verticales; los usos considerados por Brenner como secundarios son relegados a la planta sótano, mucho más compartimentada (Figs. 08 y 09).

Daniel Brenner's project for the city of Madison makes it clear in his introduction that it is inspired by the Museum for a Small City²⁰, and, as Mies already did, it focuses on conceiving the museum as a structure comprised of three basic elements - floor slab, columns and roof plate,- patios and a flexible use of space²¹. The proposed structural scheme has a square geometry with the classic division of the square in 3 x 3 modules, where each vertex corresponds to a symmetrical column formed of two I-sections, created by welding the equivalent of one European IPN profile to two IPN half-profiles. The functional programme is no longer resolved in a single floor but instead on three differentiated levels: the ground floor and the first floor function as more or less flexible, diaphanous spaces, thanks to the arrangement of a marble core containing the vertical installations and circulations; the uses considered by Brenner as secondary are relegated to the basement, which is much more compartmentalised (Figs. 08 and 09).



El museo en planta baja se apropia de un gran espacio exterior acotado mediante un muro perimetral en forma de U. En uno de los lados estrechos dispone el acceso principal mediante un atrio, significado por el desplazamiento de la cubierta. El módulo estructural ordena el espacio interior y genera un espacio umbral en el inicio del patio, en cuyo extremo opuesto se dispone una losa que lo atraviesa, protegiendo dos accesos enfrentados situados en los lados largos del rectángulo. Todo lo que no es muro, es vidrio, quedando el museo acristalado en su secuencia exterior-interior-patio. El espacio, es reivindicado por Brenner como "libre de columnas," sin embargo, este objetivo no logra conseguirlo. Los pilares están presentes en el interior de la planta baja, sin estar en coincidencia ni con los muros ni con el vidrio. En la planta primera recupera la geometría cuadrada de 3 x 3 que estructura el edificio, disponiendo los pilares perimetrales en el exterior y construyendo el plano de vidrio contra las alas de los IPN.



The museum on the ground floor occupies a large exterior space enclosed by a U-shaped perimeter wall. On one of the narrow sides it has the main entrance, by means of a foyer, indicated by the displacement of the roof. The structural module arranges the interior space and generates a threshold space at the start of the courtyard, at the opposite end of which is a slab that crosses it, protecting two entrances that face each other, located on the long sides of the rectangle. Everything that is not a wall is glass, leaving the museum glazed in its sequence of exterior-interior-courtyard. Brenner asserts that the space is "completely free of columns," although he fails to achieve this goal. The columns are present inside the ground floor, without coinciding with either the walls or the glass. On the first floor, he recovers the 3x3 square geometry which structures the building, arranging the perimeter columns on the outside and constructing the glass plane against the wings of the IPN.

Fig. 08. Daniel Brenner, An Art Museum, (IIT Chicago), 1949; plantas de distribución.

Fig. 09. Daniel Brenner, An Art Museum (IIT Chicago), 1949; vistas de la maqueta.

Fig. 08. Daniel Brenner, An Art Museum, (IIT Chicago), 1949; plans.

Fig. 09. Daniel Brenner, An Art Museum (IIT Chicago), 1949; views of the model.

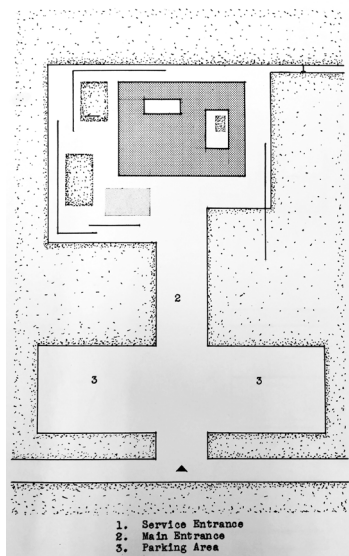
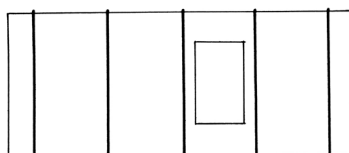
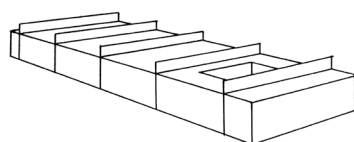


Fig. 10. Jan Lippert, *A Museum* (IIT Chicago), 1956; situación.

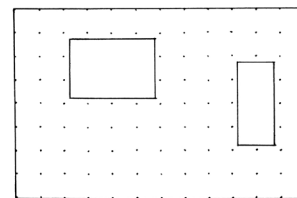
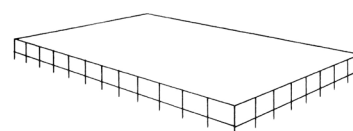
Fig. 11. Jan Lippert, *A Museum* (IIT Chicago), 1956; estudios estructurales.

Fig. 10. Jan Lippert, *A Museum* (IIT Chicago), 1956; site plan.

Fig. 11. Jan Lippert, *A Museum* (IIT Chicago), 1956; structure studies.



Scheme A



Scheme B

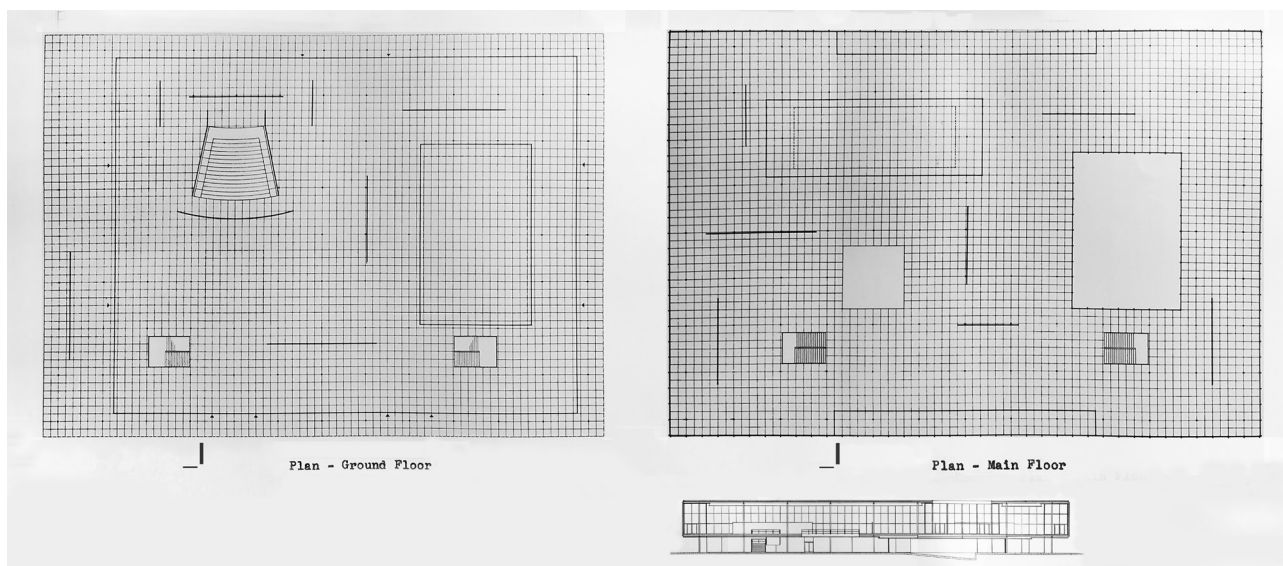
Structure Studies

El volumen sobresale respecto de los muros que delimitan la parcela y se perfora en su parte central, configurando un patio que evita la posible presencia de zonas oscuras. Esta planta está delimitada en sus cuatro lados por planos acristalados cuya carpintería repite el módulo y acentúa la división en cuatro. De este modo, la planta superior sobresale 1/4 del módulo mostrando una perfecta coincidencia con las particiones del vidrio. Asimismo, la losa se sustenta por la cara interior de los pilares, ofreciendo esa tangencia tan característica de Mies que desplaza el pilar al plano exterior y desafía la lógica de la gravedad.

El trabajo fin de máster de Jan Lippert estudia las posibilidades de aquellos conceptos que considera fundamentales para conseguir un espacio donde la sociedad aprenda y se divierta. Para ello, afirma, la forma y la función deben ser libres²². La significancia de este espacio de uso festivo se aprecia en su esquema de implantación, estableciendo una secuencia de acceso, a través de un eje central, en donde el hombre contemporáneo, se desprende de la máquina, y se introduce en un espacio previo controlado con jardines y estanques; un entorno que prepara el alma para el disfrute del arte y ofrece perspectivas y aperturas mediante la disposición de muros desplazados entre sí. Verdaderamente esta planta recuerda a la del Museo para una Pequeña Ciudad, un rectángulo con dos vacíos

The volume stands out from the walls that delimit the plot and is perforated in its central part, configuring a courtyard that avoids the possible presence of dark areas. This floor is delimited on its four sides by glazed planes whose carpentry repeats the module and accentuates the division into four. As a result, the upper floor protrudes 1/4 of the module, perfectly coinciding with the glass partitions. Similarly, the slab is supported by the inner face of the columns, demonstrating the tangency so characteristic of Mies that displaces the column to the outer plane and defies the logic of gravity.

Jan Lippert's master's thesis studies the possibilities of the concepts he considers fundamental in order to achieve a space in which society learns and enjoys itself. To do so, he says, form and function must be free²². The significance of this space for festive use can be seen in its construction design, establishing an access sequence through a central axis, in which contemporary man detaches himself from the machine and enters a previously controlled space with gardens and ponds; an environment that prepares the soul for the enjoyment of art and offers different perspectives and openings by displacing the walls. This floor plan is genuinely reminiscent of that of the Museum for a Small City, a rectangle with two voids and an



y un entorno acotado, aunque en este caso los muros permiten un límite más abierto del entorno exterior del museo (Fig. 10).

Para lograr la forma libre Lippert explica que es necesario una estructura sencilla y económica, solamente viable en acero; para la función libre, son imprescindibles dos plantas que potencien el espacio flexible y transformable. Estructuralmente propone dos alternativas. El esquema A responde a un sistema *clear-span* de planta lineal compuesta por cuatro módulos con un patio y dos vuelos en los lados menores de 1/4 de módulo. Apparently the building seems to be on the ground and has no intermediate pillars. On the contrary, the scheme B is a rectangular plan of 8 x 12 square modules resolved using a grid of pillars and two double interior heights rectangular rotated 90 degrees. Here, the building stands on pillars, generating a ground floor that acts as a transition between the ground and the main floor (Fig. 11). Functionally Lippert exposes that the best option is to have a building of two floors above ground level (Figs. 12 and 13). The zero level is defined by a glass enclosure without pillars, and whose space is organized into structural modules and exempt walls, allowing the configuration of free spaces and an amphitheatre. The access stairs to the upper floor are located opposite each other, with a module displaced with respect to the midpoint

enclosed environment, although in this case the walls allow for a more open boundary of the museum's external environment (Fig. 10).

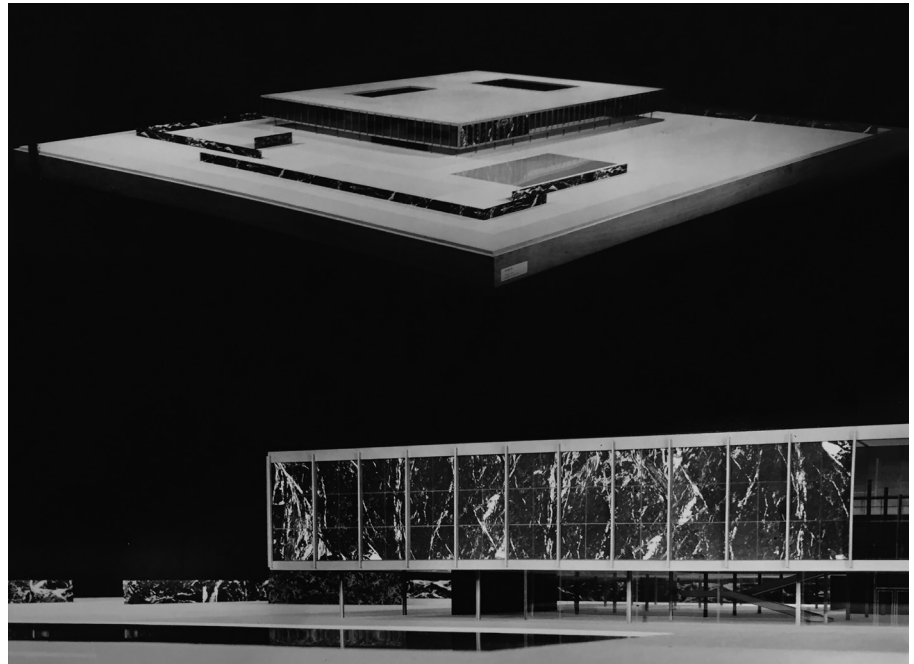
In order to achieve the free form, Lippert explains that it is necessary to have a simple and economic structure, which is only feasible in steel; for the free function, two floors are essential, which enhance the flexible and transformable space. Structurally, he proposes two alternatives. Scheme A corresponds to a *clear-span* system with a linear layout composed of four modules with a courtyard and two overhangs on the smaller sides of 1/4 of a module. Apparently, the building seems to be on the ground and has no intermediate columns. On the contrary, scheme B is a rectangular plan of 8 x 12 square modules resolved using a grid of columns and two double rectangular interior heights that are rotated 90 degrees. In this case, the building stands on columns, creating a ground floor that acts as a transition between the ground and the main floor (Fig. 11). At functional level, Lippert states that the best option is to have a two-storey building above ground level (Figs. 12 and 13). The zero level is defined by a glass enclosure without columns, whose space is organized into structural modules and exempt walls, allowing the configuration of free spaces and an amphitheatre. The access stairs to the upper floor are located opposite each other, with a module displaced with respect to the midpoint

Fig. 12. Jan Lippert, *A Museum* (IIT Chicago), 1956; plantas y sección.

Fig. 12. Jan Lippert, *A Museum* (IIT Chicago), 1956; plan and section.

Fig. 13. Jan Lippert, A Museum (IIT Chicago), 1956; vistas de la maqueta.

Fig. 13. Jan Lippert, A Museum (IIT Chicago), 1956; views of the model.



punto medio e indicando la dirección del acceso. Los dos vacíos realmente son espacios a doble altura que conectan las dos plantas. La conexión espacial de mayor dimensión hace de contrapunto respecto a la otra gran pieza, el anfiteatro, ofreciendo la posibilidad de expansión espacial en planta baja. La planta primera, vuela uniformemente en todo el perímetro 1/3 del módulo. En la sección se aprecia con claridad la conexión de las dos plantas mediante las dobles alturas y la disposición de un patio en planta primera de proporciones rectangulares que introduce luz adicional a este espacio. Ni el patio, ni las dobles alturas, ni la mayor parte de los muros coinciden con la malla de pilares interiores, creando así un juego de llenos, vacíos y planos similar al del espacio exterior, en donde las zonas ajardinadas, las láminas de agua y los muros, potencian las sensaciones de un espacio dinámico, expansible, isótropo y continuo, organizado con libertad.

Dos años después, Peter Carter describe el museo como un lugar de cobijo del arte, un lugar que debe poseer tres aspectos fundamentales: racionalidad, estética y espiritualidad. La respuesta a estos tres componentes solo es posible desde el estudio estructural (Fig. 14). Su análisis abarca tres esquemas de geometría cuadrada, de idénticas

and indicating the direction of access. The two voids are really double-height spaces that connect the two floors. The larger spatial connection acts as a counterpoint to the other large section, the amphitheatre, offering the possibility of spatial expansion on the ground floor. The first floor uniformly overhangs the whole of the perimeter by one-third of the module. The cross-section clearly shows the connection of the two floors by means of the double heights and the arrangement of a rectangular courtyard on the first floor that allows additional light into this space. Neither the courtyard, nor the double heights, nor most of the walls coincide with the grid of internal pillars, creating an interplay of full and empty spaces and planes similar to that of the exterior space, in which the landscaped zones, the sheets of water and the walls enhance the sensations of a dynamic, expandable, isotropic and continuous space, which is freely organised.

Two years later, Peter Carter describes the museum as a place for sheltering art, a place that must have three ubiquitous aspects: rational, aesthetic and spiritual content. The response to these three components is only possible through a structural study (Fig. 14). His analysis covers three schemes of square geometry, of identical dimensions

dimensiones y en donde ningún modelo tiene pilares interiores: los esquemas 1 y 2 proponen cuatro pilares dispuestos dos a dos en caras opuestas y vigas cruzadas; el esquema 3 resuelve el cuadrado en una división de 5 x 5 módulos y organiza los pilares en los módulos extremos volando las esquinas de forma que éstas se ven libres de pilares. Se trata de ocho pilares, dos por cara, que dan soporte a una losa bidireccional.

Para determinar la implantación de la pieza cuadrada del museo, Carter también hace tres estudios (Fig. 15). El esquema A muestra la pieza del museo insertada simétrica y equidistante en un recinto cuadrado superior conformado por el muro perimetral que delimita el espacio exterior. Únicamente dos

and in which none of the models has internal columns: schemes 1 and 2 propose four columns arranged two by two on opposite sides and with crossed beams; scheme 3 resolves the square in a division of 5 x 5 modules and organizes the columns in the outermost modules, cantilevering the corners so that they are free of columns. The structure has eight columns, two per face, which support a bidirectional slab.

To determine the implantation of the square section of the museum, Carter also made three studies (Fig. 15). Scheme A shows the museum piece inserted symmetrically and equidistant in a square upper enclosure formed by the perimeter wall that delimits the outer space. Only two

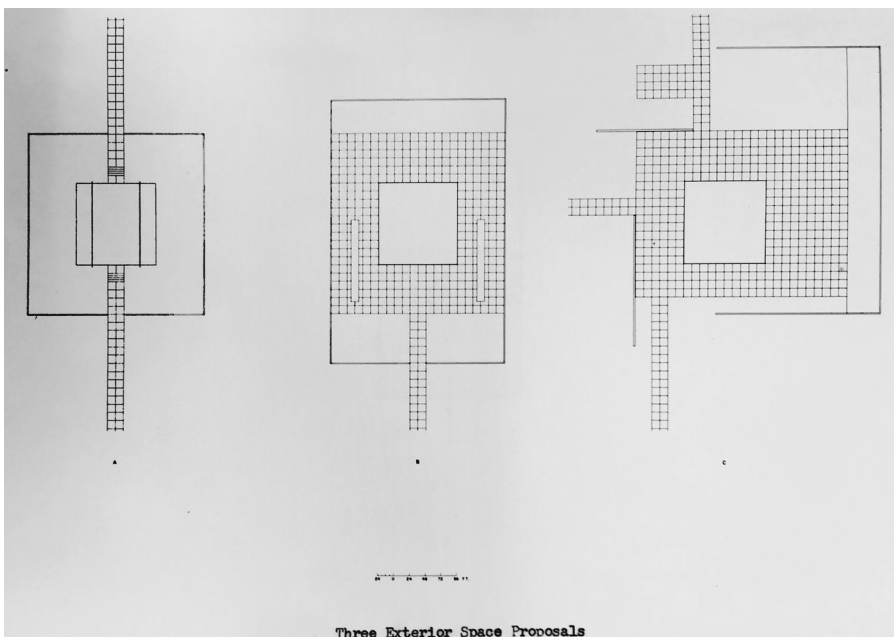
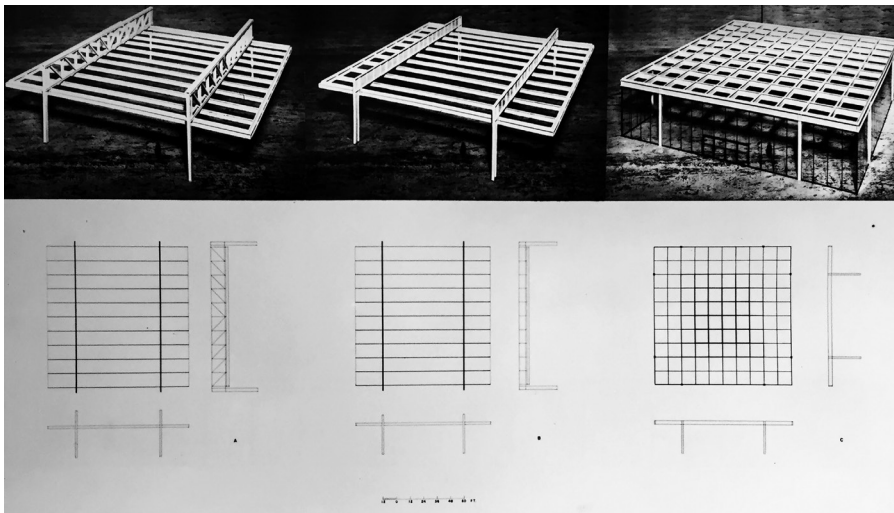


Fig. 14. Peter Carter, *An Art Museum (IIT Chicago)*, 1958; propuestas estructurales.

Fig. 15. Peter Carter, *An Art Museum (IIT Chicago)*, 1958; propuestas de implantación y tratamiento de exteriores.

Fig. 14. Peter Carter, *An Art Museum (IIT Chicago)*, 1958; structural proposals.

Fig. 15. Peter Carter, *An Art Museum (IIT Chicago)*, 1958; enclosure and exterior space proposal.

aperturas estrictas atraviesan el límite por lados opuestos, indicando el recorrido de acceso mediante un camino recto pavimentado. En el esquema B el cuadrado edificado se sigue ubicando en el centro, pero el muro perimetral se transforma en rectángulo y la geometría cuadrada se recupera con pavimento. De este modo, el conjunto queda tensionado en su eje de acceso, ofreciendo mayores superficies libres y valorando sutilmente una jerarquización de espacios libres alrededor del museo. Aquí, el acceso no es pasante y solo una apertura rompe la continuidad del plano perimetral, dando paso a un camino que desembarca en la plataforma pavimentada que hace de antesala al interior del cuerpo principal. Mientras que la opción A carece de espacio exterior estancial, la B sí ofrece un espacio perimetral al cubo acristalado donde poder estar al exterior. No obstante, es la opción C, la finalmente elegida, donde Carter quiebra el perímetro, abre perspectivas y rompe la proporción estática del espacio exterior. A partir de aquí, propone un programa funcional organizado en una planta sótano -lugar de exposición de las pinturas- y una planta baja en continuidad con el espacio exterior donde sitúa, tanto fuera como dentro,

strict openings cross the boundary on opposite sides, indicating the access route by means of a straight paved road. In scheme B, the built square is still located in the centre, but the perimeter wall is transformed into a rectangle and the square geometry is recovered with paving. As a result, the ensemble is tensioned along its entrance axis, providing larger open surfaces and subtly supporting a hierarchy of open spaces around the museum. In this case, access is not achieved by walking through, and only one opening breaks the continuity of the perimeter plane, giving way to a path that disembarks on the paved platform that serves as an antechamber to the interior of the main body. While option A does not have a stand-alone external space, option B does provide a perimeter space to the glass cube, where it is possible to be outdoors. However, it is option C, the one that was finally chosen, where Carter breaks the perimeter, opens perspectives, and breaks the static proportion of external space. From here, he proposes a functional programme organised in a basement - the area where the paintings are exhibited - and a ground floor in continuity with the exterior space - where he situates the

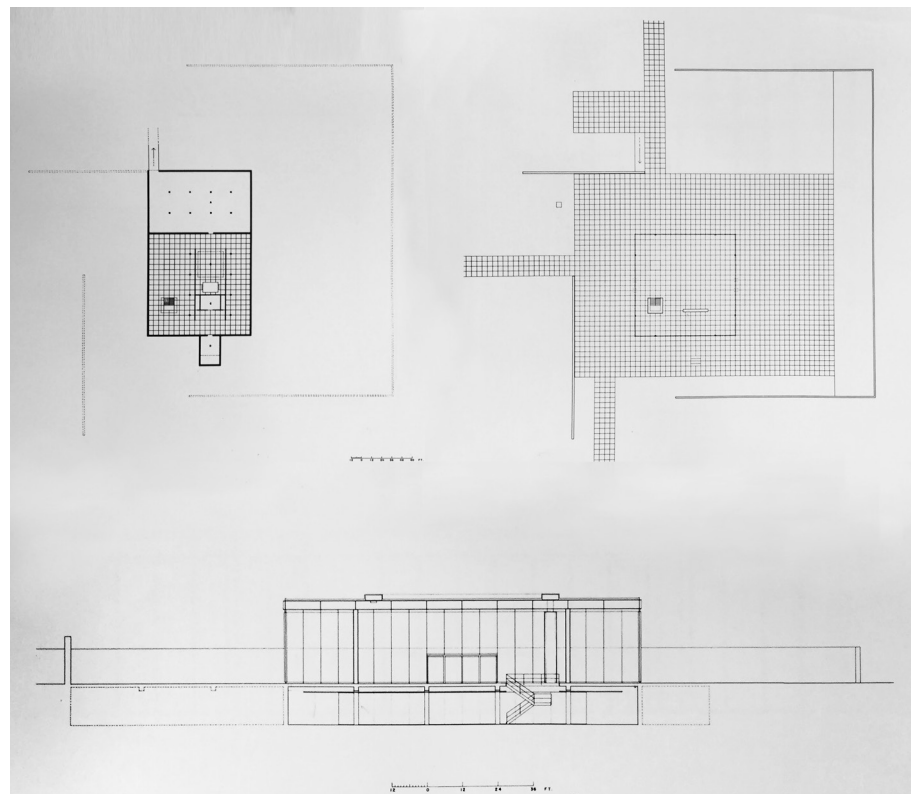


Fig. 16. Peter Carter, An Art Museum (IIT Chicago), 1958; plantas y sección.

Fig. 16. Peter Carter, An Art Museum (IIT Chicago), 1958; plans and sections.



el arte de la escultura. Y es que el modo de representar el pavimento ininterrumpido, junto con la existencia de vidrio continuo y perimetral, desdibuja claramente los límites entre interior y exterior. El espacio principal de planta baja es un gran espacio unitario, únicamente ocupado por la escalera que comunica ambos niveles y un plano vertical que resuelve las instalaciones. Todo lo demás es libre e isótropo, quedando los ocho pilares, dos por lado y sin tocar la esquina, fuera del recinto interior del museo (Figs. 16, 17 y 18).

Una vez analizadas y comparadas las tesis fin de máster sobre museos y que fueron supervisadas por Mies se extraen las siguientes coincidencias y divergencias. En primer lugar, los tres proyectos se preguntan en su prefacio qué es un museo. Ninguno habla de un programa funcional, sino que cuestionan la naturaleza de aquello que van a proyectar. Estas palabras no solo recuerdan la memoria del Museo para una Pequeña Ciudad, sino las palabras del propio Mies en su discurso de acceso al AIT: “Queremos saber lo que puede ser, lo que debe ser y lo que no puede ser. Por tanto, queremos conocer su esencia. De esta manera analizaremos todos los fines que aparezcan y estudiaremos su carácter para convertirlo en el punto de partida de la formalización”²³. Así, para Brenner el significado de la palabra Museo viene directamente de su etimología griega, literalmente templo de musas: “diosas encargadas de la música, la poesía y las artes y las ciencias. Por eso la palabra tiene obvias connotaciones espirituales”²⁴. Brenner entiende el

sculptures, both outside and inside. The way in which the uninterrupted pavement is represented, together with the presence of continuous and perimeter glass, clearly blurs the boundaries between interior and exterior. The main space on the ground floor is a large unitary space, occupied only by the staircase that communicates both levels and a vertical plane that resolves the installations. Everything else is free and isotropic, leaving the eight columns, two on each side and without touching the corner, outside of the internal space of the museum (Figs. 16, 17 and 18).

After analysing and comparing the Master's theses on museums that were supervised by Mies, the following coincidences and divergences may be seen. First of all, the three projects question in their preface what a museum is. None of them refer to a functional program, but instead question the nature of what they are going to design. These words are not only reminiscent of the report of the Museum for a Small City, but also Mies' own words in the speech he gave on entering the AIT: “We want to know what it can be, what it must be, and what it should not be. We want, therefore, to learn its essence. We shall examine one by one every function of a building, work out its character, and make it a basis for design”²³. And so, for Brenner the meaning of the word ‘museum’ comes directly from its Greek etymology, literally a temple of the Muses: “goddesses in charge of music, poetry and the arts and sciences. Thus the Word has obvious spiritual connotations”²⁴. Brenner understands the museum as a space for housing activities that enlighten the spirit of man,

Fig. 17. Peter Carter, An Art Museum (IIT Chicago), 1958; vista interior.

Fig. 17. Peter Carter, An Art Museum (IIT Chicago), 1958; interior view.

museo como un espacio para alojar actividades que alegran el espíritu del hombre, lo más íntimo del ser humano: una fiesta para el espíritu a través del goce de los sentidos. Para Lippert, sin embargo, el museo es el lugar donde "las personas pasan su tiempo libre con fines lúdicos y educativos"²⁵. Si bien tiene implicaciones similares, añade el concepto de ocio: en el museo el nuevo hombre aprende y se divierte. Por otro lado, Carter centra la atención en el objeto a exponer e interpreta el término museo "como un edificio que alberga una colección seleccionada y que cambia periódicamente de obras de arte"²⁶. De alguna manera pretende mantener vivo el interés por el mensaje que transmite el arte: enfrenta al ser humano con la obra de arte y con el tiempo.

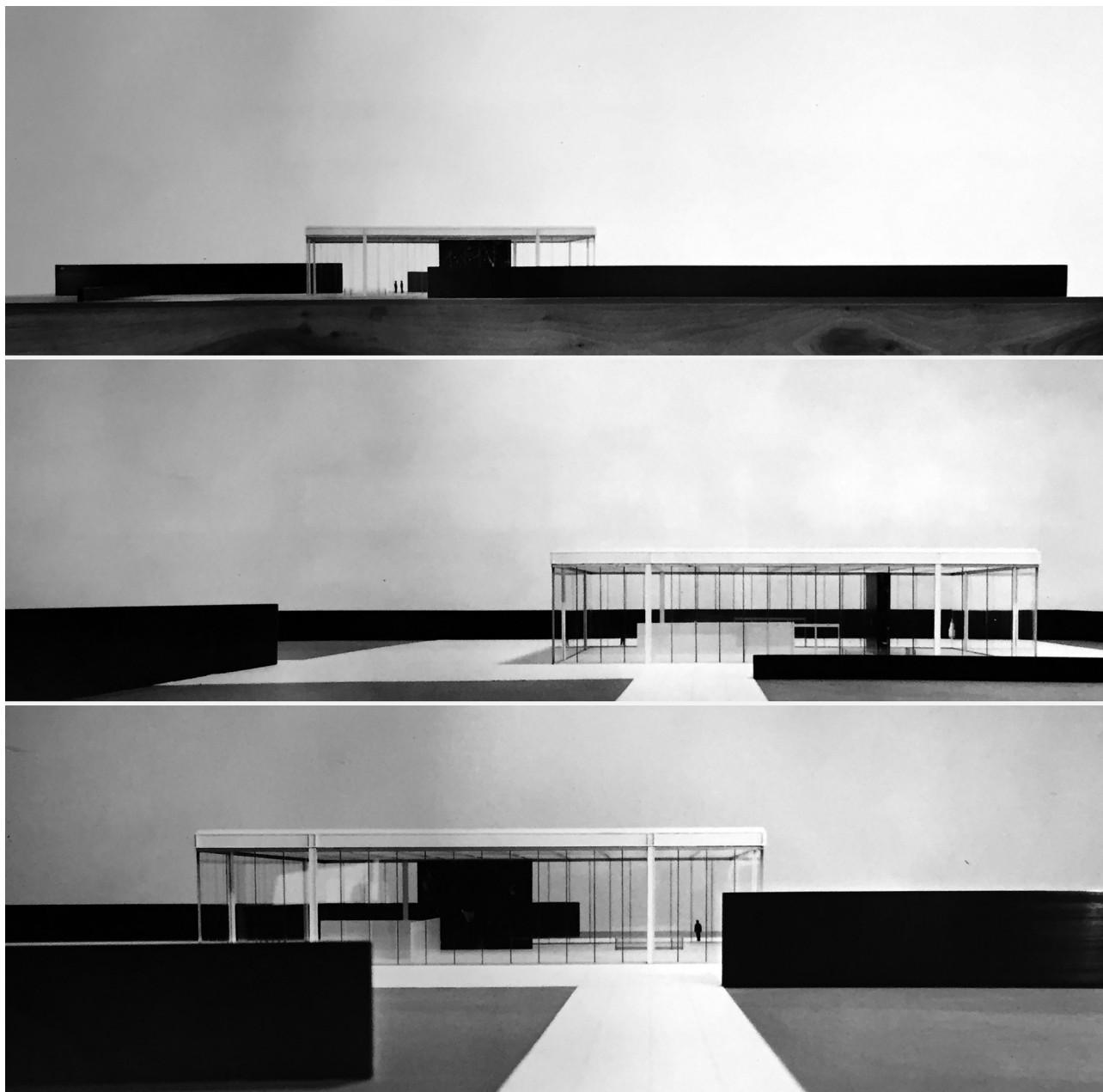
En segundo lugar, los tres trabajos inician su estudio y subsiguiente discusión arquitectónica con el problema del módulo y la estructura. En este sentido es muy clara la evolución: Brenner dispone estructura interior, Lippert plantea dos modelos, uno con estructura perimetral y otro con estructura interior (modelo elegido) y Peter Carter sólo contempla esquemas donde la estructura interior ha desaparecido. A partir de esta evolución, se puede afirmar que la estructura juega un papel fundamental en la docencia arquitectónica de Mies y también en sus proyectos, de forma que el espacio interior se va liberando de la estructura hasta quedar exento de ella y presentar un carácter más unitario. Un espacio sin estructura, sin función específica, abstracto, isótropo y transformable.

En tercer lugar, resulta ilustrativo que los tres coincidan en cómo plantear el espacio atendiendo a los límites entre interior y exterior; ambos márgenes se funden en uno gracias a los planos de vidrio y el tratamiento del plano de suelo. En los tres proyectos es evidente la importancia que adquiere el espacio exterior desde el punto de vista del goce de la obra de arte; en todos se desdibujan los límites del edificio, siendo este mecanismo un complemento imprescindible de la actividad festiva ¿dentro o fuera? De este modo, la propuesta de Brenner consiste en un espacio exterior completamente cerrado

the most intimate part of the human being: a festival for the spirit, through the enjoyment of the senses. For Lippert, however, the museum is a place "where the people spend their leisure time for education and recreation"²⁵. Although it has similar implications, he adds the concept of leisure: in the museum the new man learns and enjoys himself. On the other hand, Carter focuses his attention on the object to be exhibited and interprets the term 'museum' "as a building housing a selected and periodically changing collection of works of art"²⁶. In some way he intends to keep alive the interest in the message that art conveys: he confronts the human being with the work of art and with time.

Secondly, all three works begin their study and subsequent architectural discussion with the problem of the module and the structure. In this sense, the evolution is very clear: Brenner has an interior structure, Lippert proposes two models, one with a perimeter structure and the other with an interior structure (the selected model), and Peter Carter only contemplates designs in which the interior structure has disappeared. Based on this evolution, it can be said that the structure plays a fundamental role in Mies' architectural teaching and also in his design, whereby the inner space is freed from the structure to the point where it is exempt from it, and presents a more unitary character. A space created without structure, without any specific function, abstract, isotropic, and transformable.

Thirdly, it is illustrative that all three coincide in how to plan the space taking into account the limits between the interior and exterior; both margins merge into one thanks to the glass planes and the treatment given to the floor plane. In all three projects it is clear to see the importance that the exterior space acquires from the point of view of the enjoyment of the work of art; in all of them, the limits of the building are blurred, this mechanism being an essential complement to the festive activity, inside or outside? In this way, Brenner's proposal consists of an exterior space that is completely enclosed and controlled by



y controlado por los planos verticales que delimitan el conjunto. No hay fugas visuales, no hay dinamismo, es un espacio estático, un lugar de celebración controlado y en conexión con la planta baja, punto de paso obligado con el espacio del patio. Lippert establece una secuencia de acceso al final de la cual se sitúa el espacio exterior que complementa al museo. Se trata de un amplio espacio abierto, parcialmente acotado por planos discontinuos desfasados que ofrecen perspectivas abiertas. El tratamiento de este plano exterior se funde con el interior en una continuidad tanto de materiales como de distribución. Así, en el exterior,

the vertical planes that delimit the whole. There are no visual 'leaks', there is no dynamism: it is a static space, a place of controlled celebration, and in connection with the ground floor, an obligatory point of passage with the patio space. Lippert establishes an access sequence at the end of which is the external space that complements the museum. It is a wide-open space, partially delimited by discontinuous planes that are out of phase, and which offer open perspectives. The treatment given to this external plane merges with the interior in a continuity of both their materials and distribution. As a result, in the exterior, gardens, ponds and

Fig. 18. Peter Carter, An Art Museum (IIT Chicago), 1958; vistas de la maqueta.

Fig. 18. Peter Carter, An Art Museum (IIT Chicago), 1958; views of the model.

se disponen jardines, estanques y planos, igual que en el interior lo hacen anfiteatros, patios y escaleras. El resultado es una identificación absoluta entre el exterior y el interior, entendiendo el exterior como lugar de exposición al aire libre y, por tanto, vinculado a las actividades artísticas. Finalmente, Carter nos presenta un espacio exterior cerrado por tres de sus lados y abierto por el lado que da a los accesos principales. Se da también la continuidad de pavimentos y la libertad de circulación por este espacio, pero claramente se trata de un espacio tensionado, tiene un detrás estático y un delante dinámico.

Conclusiones

Esta investigación ha analizado la relación entre la docencia y la arquitectura de Mies van der Rohe tomando como objeto de estudio los proyectos de museo. Tanto el Museo para una Pequeña Ciudad como los proyectos que Mies supervisó en el IIT abordaban tres cuestiones principales: la esencia del significado, el módulo estructural y la relación interior y exterior de un espacio concebido lo más flexible posible. Preguntas y respuestas que fueron la antítesis de la práctica consagrada de los museos decimonónicos y en donde lo importante era conseguir un espacio para el disfrute del arte de una sociedad nueva (Fig. 19).

El estudio de las tesis que Mies supervisó como docente evidencian similitudes con los trabajos que Mies desarrollaba en su despacho. Así el "Art Museum" de D. Brenner presenta muchas semejanzas con los proyectos de Casa Patio de Mies de su final europeo, la propuesta de J. Lippert con el Museo para una Pequeña Ciudad y el proyecto de P. Carter con el edificio Ron Bacardí de Santiago de Cuba o la Neue Nationalgalerie de Berlín. ¿Son investigaciones que comienzan en las aulas y continúan en su estudio?, ¿o es al revés? La identidad entre el Mies arquitecto y el Mies profesor está clara; pero sus límites no. Y es que no se puede establecer cuándo comienza una actividad y termina la otra, puesto que su pensamiento, obra, y método docente avanzan en una misma

planes are arranged in the same way as the amphitheatre, courtyards and staircases are in the interior. The result is an absolute identification between the exterior and the interior, where the exterior is considered as a place of exhibition in the open air and, therefore, connected with artistic activities. Finally, Carter presents us an external space which is enclosed to three of its sides and it is open on the side facing the main entrances. There is also continuity in the paving and freedom of movement in this space, although it is a clearly a tensioned space, with a static rear and a dynamic front.

Conclusions

This study has analysed the relationship between the teaching and the architecture of Mies van der Rohe, focusing on museum projects. Both the Museum for a Small City and the projects that Mies supervised at the IIT addressed three main issues: the essence of meaning, the structural module, and the interior and exterior relationship of a space that was conceived to be as flexible as possible. Questions and answers were the antithesis of the consecrated practice of nineteenth-century museums, where the most important element was to achieve a space for the enjoyment of the art of a new society (Fig. 19).

The study of the theses that Mies supervised as a professor reveals similarities with the works that Mies designed in his studio. D. Brenner's "Art Museum" has many similarities with Mies' courtyard houses in his final European stage; J. Lippert's design with the Museum for a Small City; and P. Carter's project with the Ron Bacardi Building in Santiago de Cuba, or the New National Gallery of Berlin. Are these investigations that began in the lecture rooms and continued in his studio? Or was it the other way around? The identity between Mies the Architect and Mies the professor is clear; but his limits are not. And it is not possible to establish when one activity begins and the other ends, since his thought, work, and teaching method

dirección. Y no cabe duda de que su última obra, la Neue Nationalgalerie es el resumen de su labor profesional, su labor docente y su investigación llevada a cabo desde Alemania hasta Chicago y desde Chicago hasta Alemania. Una experiencia acumulada y depurada con base a la estructura, el cerramiento y la sociedad de la época. Para el Mies americano la arquitectura trasciende más allá de la función; el espacio unitario la supera. La función es efímera, cambiante, y sin embargo la arquitectura debe permanecer invariante. Y así, hablando de estructura, cerramiento y sociedad, y relacionándolos con el espacio universal, unitario, flexible... no se puede acabar sin mencionar el gran sueño miesiano, el Convention Hall de Chicago. Su composición tripartita del collage evidencia estas tres preocupaciones: la estructura conformando el plano de techo, la materialidad en la franja central del cerramiento y en el plano de suelo la sociedad festejando el espacio sin límites.

all progress in the same direction. And there can be no doubt that his last work, the New National Gallery, sums up his professional work, his teaching work, and the research he carried out from Germany to Chicago and from Chicago to Germany. It meant an accumulated and refined experience, based on the structure, the enclosure, and the society of the time. For the American Mies, architecture transcends beyond function; the unitary space surpasses it. The function is ephemeral, changing, and yet architecture must remain unchanged. And so, when we are referring to structure, enclosure, and society, and relating them to universal, unitary, and flexible space, we cannot end without mentioning Mies' greatest dream, the Chicago Convention Hall. Its three-part composition as a collage evidences these three concerns: the structure shaping the ceiling plane, the materiality in the central strip of the enclosure, and in the floor plane, society celebrating the space without limits.

OFICINA / OFFICE	Court Houses. 1930-1935 Mies van der Rohe	Museum for a Small City. 1942 Mies van der Rohe	Neue Nationalgalerie. 1962-1968 Mies van der Rohe
AULA / CLASSROOM	An Art Museum. 1949 Daniel Brenner	A Museum. 1956 Jan Lippert	An Art Museum. 1958 Peter Carter
CONCEPTO / CONCEPT	¿Qué es un museo? What is a museum? Disfrute del arte / Enjoying art Actividades para el espíritu Activities for the spirit	¿Qué es un museo? What is a museum? Disfrute del arte / Enjoying art Actividades para aprender y divertirse Activities for education and recreation	¿Qué es un museo? What is a museum? Disfrute del arte / Enjoying art Enfrentar hombre, arte y tiempo Confront human being art and time
MÓDULO Y ESTRUCTURA / GRID & STRUCTURE	Estructura interior Interior structure	Estructura interior Interior structure	Estructura exterior Exterior structure
EXTERIOR INTERIOR	Límite cerrado / Closed boundary Espacio estático / Static space Distinto tratamiento interior-exterior Different treatment inside-outside	Límite abierto / Open boundary Espacio dinámico / Dynamic space Tratamiento unitario interior-exterior Same treatment inside-outside	Límite abierto / Open boundary Espacio estático y dinámico Dynamic and static space Tratamiento unitario interior-exterior Same treatment inside-outside

Fig. 19. Tabla de conclusiones.

Fig. 19. Table of conclusions.

Notas

1. Mies van der Rohe, "Museum for a Small City", *Architectural Forum* 78 (may 1943): 84.
2. Tras el proyecto del Museo para una Pequeña Ciudad, el estudio de Mies no se vio involucrado en un proyecto de museo hasta 1950, fecha en que comenzó a desarrollar el ala Cullinan del Museum of Fine Arts of Huston. Diez años después proyectó por primera vez un museo de nueva planta, el Georg Schaefer Museum, emplazado en Schweinfurt, Alemania. En esta ocasión, Mies tomó como referencia el proyecto del Bacardí Office Building, el cual también fue antecedente de su último espacio de arte construido, la Neue Nationalgalerie de Berlín. La publicación que mejor detalla esta evolución es el libro editado por Phyllis Lambert, *Mies in América* (Whitney Museum of American Art New York, & Canadian Centre for Architecture Montréal, 2001).
3. Mies van der Rohe, "Discurso de ingreso como director del Departamento de Arquitectura del Armour Institute of Technology", recogido en Fritz Neumeyer, *Mies van der Rohe: La palabra sin artificio. Reflexiones sobre arquitectura 1922-1968* (Madrid: El Croquis, 1995), 481.
4. De acuerdo con Cammie MacAtee, el Museo para una Pequeña Ciudad es un proyecto con implicaciones docentes, ya que fue desarrollado en estrecho vínculo con sus alumnos de posgrado George Danforth. "El proyecto arroja luz sobre muchos aspectos esenciales de la actitud de Mies con respecto a la arquitectura y de su relación con los estudiantes durante los veinte años de su enseñanza en Chicago (...) ¿Fue el encargo de la revista el que dirigió el proyecto de tesis de Danforth hacia otra dirección y que favoreció el principio de un nuevo proyecto?". Cammie McAtee, "Le musée pour une petite ville," *Genesis* 14 (2000): 220. "Terminamos el proyecto, que era mi tesis para la publicación y fue publicado, como debía ser. Todo fue bien, y obtuve un beneficio maravilloso de trabajar con Mies en ello." George Danforth, "Oral history of George Danforth," interviewed by Pauline Saliga, compiled under the auspices of the Chicago Architects Oral History Project, the Ernest R. Graham Study Center for Architectural Drawings, Department of Architecture, The Art Institute of Chicago, August 1986, transcription 38, <http://www.artic.edu/aic/libraries/caohp/>
5. A partir de finales del siglo XIX, y gracias a los manifestos reformistas de personalidades como Thomas More, Francis Bacon, Locke o Montesquieu, el museo se entiende como un espacio democrático de culto al arte en donde cualquier usuario, independientemente de su clase social, tiene acceso a su continente y a su contenido. Como consecuencia de la reivindicación del derecho de acceso a la cultura, materializado en edificios como el *Altes Museum* de Berlín de Karl Friedrich Schinkel, los principales arquitectos del siglo pasado teorizaron al respecto y buscaron la oportunidad de construir un espacio plural para el festejo del arte.
6. Mies van der Rohe, "Museum for a Small City," 84.

Notes

1. Mies van der Rohe, "Museum for a Small City", *Architectural Forum* 78 (May 1943): 84.
2. After the Museum for a Small City project, Mies' studio was not involved in a museum project until 1950, when it began designing the Cullinan wing of the Museum of Fine Arts of Huston. Ten years later, he designed a new museum for the first time, the Georg Schaefer Museum, located in Schweinfurt, Germany. On this occasion, Mies used as a reference the Bacardi Office Building project, which was also the antecedent of his last built art space, the New National Gallery in Berlin. The publication that best details this evolution is the book edited by Phyllis Lambert, *Mies in America* (Whitney Museum of American Art New York, & Canadian Centre for Architecture Montréal, 2001).
3. Mies van der Rohe, "Inaugural Address as Director of Architecture at Armour Institute of Technology", in Fritz Neumeyer, *Mies van der Rohe: La palabra sin artificio. Reflexiones sobre arquitectura 1922-1968* (Madrid: El Croquis, 1995), 481.
4. According to Cammie MacAtee, the Museum for a Small City is a project with educational implications, as it was designed in close collaboration with his graduate student George Danforth. "The project sheds light on many essential aspects of Mies' attitude towards architecture and his relationship with students during the twenty years of his teaching in Chicago (...) Was it the magazine's commission that directed Danforth's thesis project in another direction and favored the beginning of a new project?". Cammie McAtee, "Le musée pour une petite ville," *Genesis* 14 (2000): 220. "We finished the project, which was my thesis for the publication and it was published, as it should have been. Everything was fine, and I got marvelous benefit out of working with Mies on it..." George Danforth, "Oral history of George Danforth," interviewed by Pauline Saliga, compiled under the auspices of the Chicago Architects Oral History Project, the Ernest R. Graham Study Center for Architectural Drawings, Department of Architecture, The Art Institute of Chicago, August 1986, transcription 38, <http://www.artic.edu/aic/libraries/caohp/>
5. From the end of the 19th century onwards, and thanks to the reformist manifestos of figures such as Thomas More, Francis Bacon, Locke or Montesquieu, the museum is understood as a democratic space for the admiration of art in which any user, regardless of social class, has access to its continent and its content. As a consequence of the claim to the right of access to culture, materialized in buildings such as Karl Friedrich Schinkel's *Altes Museum* in Berlin, the main architects of the last century theorized about it and sought the opportunity to build a plural space for the celebration of art.
6. Mies van der Rohe, "Museum for a Small City," 84.

7. José Santatecla Fayos, Vicente Mas Llorens and Laura Lizondo Sevilla, "The Crown Hall. Context and project," *Proyecto, Progreso, Arquitectura*, no. 1 (May 2010): 58.

8. Mies van der Rohe, "Museum for a Small City," 84.

9. Wolf Tegethoff, "El concepto de Museo de Mies van der Rohe." Conferencia registrada en la Sala de Actos del COAC el 16 de abril de 1986, dentro del ciclo de conferencias "Centenario del nacimiento de Mies van der Rohe."

10. Mies van der Rohe, "Museum for a Small City," 84.

11. Beatriz Colomina, "La casa de Mies: exhibicionismo y coleccionismo," 2G, no. 48-49 Mies van der Rohe. Casas (2009):18.

12. Beatriz Colomina, "La casa de Mies," 21.

13. Wolf Tegethoff, "El concepto de Museo de Mies van der Rohe."

14. De entre las pocas publicaciones que tratan en exclusividad la labor docente de Mies, destacan: la monografía realizada Pao Chi Chang y Alfred Swenson, *Architectural Education at IIT, 1938-1978* (Chicago: Illinois Institute of Technology, 1980), la cual muestra algunos de los proyectos tesis de postgrado, pero de forma escueta, meramente descriptiva y sin relacionarlas con la obra de Mies; y dos publicaciones surgidas como catálogos de exposiciones con motivo del centenario del nacimiento de Mies: *The Unknown Mies van der Rohe and his Disciples of Modernism* y *Mies van der Rohe: Architect as Educator*.

15. "Su constante búsqueda de la arquitectura refleja que las aulas se convirtieron en el segundo laboratorio de ideas de su oficina. Además, su voluntad era explorar las ideas antes de llegar a una solución final. En respuesta a esto, desarrolló una fluida relación entre su oficina y el aula, y los problemas se cruzaron libremente entre los ámbitos de la teoría y la práctica. No era inusual desarrollar una tesis de posgrado en paralelo con un proyecto de la oficina similar, y era aún más probable que un proyecto de un alumno abordara un programa que ya se había estudiado en la oficina, e incluso construido." Cammie D. MacAtee, "Mies van der Rohe and Architectural Education. The Curriculum at the Illinois Institute of Technology. Students Projects and Built Work" (PhD diss., Queen's University Kingston, Ontario, Canada, 1996), 77. Traducción propia.

16. Existen dos tesis más cuyos títulos pueden sugerir su vinculación con la tipología museística: Vera Jansone, "Art's Club." (Degree of Master of Science in Architecture in the Graduate School of Illinois Institute of Technology, 1952) y David Haid Nelson, "An Arts Center." (Degree of Master of Science in Architecture in the Graduate School of Illinois Institute of Technology, 1953). Sin embargo, al estudiar su contenido se comprueba que no responden a museos propiamente dichos y por tanto su análisis no es vinculante para el presente artículo.

17. Daniel Brenner, "An Art Museum." (Degree of Master of Science in Architecture in the Graduate

7. José Santatecla Fayos, Vicente Mas Llorens and Laura Lizondo Sevilla, "The Crown Hall. Context and project," *Proyecto, Progreso, Arquitectura*, no. 1 (May 2010): 58.

8. Mies van der Rohe, "Museum for a Small City," 84.

9. Wolf Tegethoff, "The Museum Concept of Mies van der Rohe." "Conference held in the Assembly Hall of the COAC on April 16, 1986, as a part of the series of conferences titled "Centenary of the birth of Mies van der Rohe."

10. Mies van der Rohe, "Museum for a Small City," 84.

11. Beatriz Colomina, "Mies's house: exhibitionism and collectionism," 2G, no. 48-49 Mies van der Rohe. Houses (2009):18.

12. Beatriz Colomina, "Mies's house," 21.

13. Wolf Tegethoff, "The Museum Concept of Mies van der Rohe."

14. Among the few publications that deal exclusively with the teaching work of Mies, the monograph by Pao Chi Chang and Alfred Swenson, *Architectural Education at IIT, 1938-1978* (Chicago: Illinois Institute of Technology, 1980), which shows some of the graduate thesis projects, but in a short, merely descriptive way and without relating them to Mies' work; and two publications that appeared as exhibition catalogues marking the centenary of Mies' birth: *The Unknown Mies van der Rohe and his Disciples of Modernism* and *Mies van der Rohe: Architect as Educator*.

15. "The constant search involved in his approach to architecture reflect that the classroom became a second intellectual laboratory to his office. The point of the thesis, moreover, was an exploration of ideas rather than the arrival at a final solution. In response to this, a fluid relationship developed between his office and classroom, and problems crossed freely between the two realms of theory and practice. It was not unusual for a graduate thesis to develop alongside a current office project, and it was even more likely that a student project would address a program which had already been brought to resolution in the office, and possible even built." Cammie D. MacAtee, "Mies van der Rohe and Architectural Education. The Curriculum at the Illinois Institute of Technology. Students Projects and Built Work" (PhD diss., Queen's University Kingston, Ontario, Canada, 1996), 77.

16. There are two more theses whose titles may suggest their connection with the museum typology: Vera Jansone, "Art's Club". (Degree of Master of Science in Architecture in the Graduate School of Illinois Institute of Technology, 1952) and David Haid Nelson, "An Arts Center." (Degree of Master of Science in Architecture in the Graduate School of Illinois Institute of Technology, 1953). However, a study of their content reveals that they were not museums as such, and therefore their analysis is not pertinent to this article.

17. Daniel Brenner, "An Art Museum." (Degree of Master of Science in Architecture in the Graduate

School of Illinois Institute of Technology, June 1949).

18. Jan Lippert, "A Museum." (Degree of Master of Science in Architecture in the Graduate School of Illinois Institute of Technology, June 1956).

19. Peter Carter, "An Art Museum." (Degree of Master of Science in Architecture in the Graduate School of Illinois Institute of Technology, June 1958).

20. Brenner, "An Art Museum," 7.

21. Brenner, "An Art Museum," 12.

22. Lippert, "A Museum," 3.

23. Mies van der Rohe, "Discurso de ingreso como director del Departamento de Arquitectura del AIT," 481.

24. Brenner, "An Art Museum," IV.

25. Lippert, "A Museum," IV.

26. Carter, "An Art Museum," IV.

School of Illinois Institute of Technology, June 1949).

18. Jan Lippert, "A Museum." (Degree of Master of Science in Architecture in the Graduate School of Illinois Institute of Technology, June 1956).

19. Peter Carter, "An Art Museum." (Degree of Master of Science in Architecture in the Graduate School of Illinois Institute of Technology, June 1958).

20. Brenner, "An Art Museum," 7.

21. Brenner, "An Art Museum," 12.

22. Lippert, "A Museum," 3.

23. Mies van der Rohe, "Admission speech as director of the Department of Architecture of the AIT," 481.

24. Brenner, "An Art Museum," IV.

25. Lippert, "A Museum," IV.

26. Carter, "An Art Museum," IV.

Procedencia de las ilustraciones

Fig. 01. Chicago History Museum (ICHi-013825). Imagen cedida para su publicación.

Fig. 02, 04 y 05. Realizado por los autores en base a lo publicado en *Architectural Forum* 78 (may 1943): 84-85.

Fig. 03. *Architectural Forum* 78 (mayo 1943): 84-85.

Fig. 06. University Archives and Special Collections, Paul V. Galvin Library, Illinois Institute of Technology. Imagen cedida para su publicación.

Fig. 07. Realizado por los autores en base los fondos del Graham Resource Center, IIT Chicago. Imagen cedida para su publicación.

Fig. 08-18. Graham Resource Center, IIT Chicago. Imágenes cedidas para su publicación.

Fig. 19. Realizada por los autores en base a la investigación.

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Fig. 01. Chicago History Museum (ICHi-013825). Image provided for publication.

Fig. 02, 04 and 05. Made by the authors based on the contents published in *Architectural Forum* 78 (May 1943): 84-85.

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Fig. 06. University Archives and Special Collections, Paul V. Galvin Library, Illinois Institute of Technology. Image provided for publication.

Fig. 07. Made by the authors on the basis of funds from the Graham Resource Center, IIT Chicago. Image provided for publication.

Fig. 08-18. Graham Resource Center, IIT Chicago. Images provided for publication.

Fig. 19. Made by the authors on the basis of the research.

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